**Overview - Cell Structure and Function**

**Cell structure**

 *World of Anatomy and Physiology*, 2002

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[**LS1.A: Structure and Function**](http://www.nap.edu/openbook.php?record_id=13165&page=143)

* [All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=143)
* [Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)](http://www.nap.edu/openbook.php?record_id=13165&page=143)

The **cell theory**, set forth in the 1850s, states that cells are the fundamental units of life, a cell is the simplest unit capable of independent existence, and that all living things are made of cells. Cells are primarily water (90 percent). The rest of the molecules present are either proteins (50 percent), carbohydrates (15 percent), nucleic acids (15 percent), **lipids** (10 percent), or various other substances (10 percent).

Two types of cells are recognized in living things. Prokaryotes (literally, "before the nucleus") are cells that have no distinct nucleus floating around the cell. Most prokaryotic organisms are single-celled, such as **bacteria** and algae. Eukaryotic (literally, "true nucleus") organisms, on the other hand, have a distinct nucleus and a highly organized internal structure. The nucleus directs all cellular activities by controlling the synthesis of proteins, and it encodes instructions for the synthesis of proteins in a helical double-stranded molecule called **deoxyribonucleic acid** (**DNA**). The nucleus, therefore, directs all cellular activities and thus, all body processes.

Prokaryotes can grow rapidly and are widespread in the biosphere. Some of them can double size, mass, and number in 20 minutes. They are highly versatile and can survive in a wide variety of nutrients and environments. The cells of these organisms have a rigid cell wall with a cell membrane immediately inside this structure; the membrane plays a critical role in the transfer of chemicals to and from the cells. Under a microscope, grainy dark spots distinctly apparent inside the cells are called ribosomes, and these are the sites of important chemical reactions. Ribosomes do not have a membrane, and they fall into two separate units when not synthesizing protein. While sharing many common features, prokaryotes have considerable structural and biochemical diversity.

Eukaryotic cells, on the other hand are 10 to 50 times larger than prokaryotic cells. All cells of plants, animals, and fungi belong to this family. Multicellular organisms contain a vast array of highly specialized cells. Plants, for example, contain root cells, leaf cells, and **stem cells**, while humans have skin cells, nerve cells, and sex cells. Each kind of cell is structured to perform a highly specialized function. In order to meet the many different specialized functions, these cells exist in many different forms and act in a cooperative manner in multicellular organisms.

Eukaryotic cells have a substantial degree of spatial organization and differentiation, and there are numerous membrane-enclosed domains called organelles inside these cells. Besides the nuclear membrane (which clearly differentiates the nucleus), eukaryotes have a complex convoluted membrane system called the endoplasmic reticulum that creates distinct areas within the cell. The endoplasmic reticulum is also the transport system for molecules needed for certain changes and at specific destinations. The two types of endoplasmic reticulum are known as rough and smooth, with the difference being that rough endoplasmic reticulum has ribosomes attached to it, while the smooth variety does not.

Other important organelles within a eukaryotic cell include **mitochondria**, highly specialized organelles which catalyze reactions. Mitochondria are the sites of aerobic respiration, and generally are the major energy production center in eukaryotes. Mitochondria, found in the cytoplasm in round and elongated shapes, are the site of adenosine tri-phosphate (ATP) production. ATP is a molecule ultimately cleaved to provide the energy needed to drive many cellular and physiological processes. The shape, amount, and intra-cellular position of mitochondria are not fixed, and their movements inside cells are influenced by the cytoskeleton, usually being in close relationship with the energetic demands of each cell type. For instance, cells that have a high consumption of energy, such as muscular, neural, retinal, and gonadic cells usually have more mitochondria than cells with a lower energetic demand (e.g., fibroblasts and lymphocytes). Mitochondria have an inner membrane and an outer membrane; the reticulations, or many foldings of the inner membrane, serve to increase the surface area of membrane on which membrane-bound reactions can take place.

The Golgi complex and lysosomes are two other organelles that isolate chemical reactions and chemical compounds from the cytoplasm. The Golgi complex, or Golgi body, changes molecules and divides them into small membrane-contained sacs called vesicles. These sacs can be sent to various locations in the cell. The lysosome is the digestive system in the cell. It uses digestive **enzymes** to break down molecules into their base components using digestive. This demonstrates one of the reasons for having all parts of a cell compartmentalized; the cell could not use the destructive enzymes if they were not sealed off from the rest of the cell.

Chloroplasts are the site of photosynthesis in eukaryotic plant cells. They are disk-like structures composed of a single membrane surrounding a fluid containing stacks of membranous disks. Chloroplasts can be easily seen with a light microscope.

* [Cell structure](http://ic.galegroup.com/ic/scic/DocumentDispatcherPage/DocumentDispatcherWindow?action=1&javax.portlet.action=doForward&windowstate=normal&documentId=GALE%7CCV2210038592&mode=view)

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1. Citing text based evidence, describe the appearance and function of ribosomes.

2. According to the text, give the function and location of mitochondria.

3. Contrast prokaryotes with eukaryotes citing evidence from the text.

4. Cite text based evidence to describe why enzymes must be isolated from the rest of the cell.